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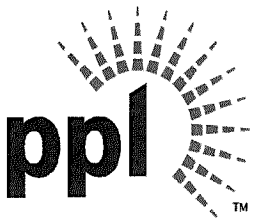

OCT 18 2011

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop OP1-17
Washington, DC 20555

SUSQUEHANNA STEAM ELECTRIC STATION
LICENSEE EVENT REPORT 50-388/2011-003-00
LICENSE NO. NPF-22
PLA-6777 **Docket No 50-388**

Licensee Event Report 50-388/2011-003-00 is being submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A), for an event or condition that resulted in the automatic actuation of the Reactor Protection System.

There were no actual consequences to the health and safety of the public as a result of these events.

No commitments were identified in this submittal.

On Behalf for Russ Kearney

F. A. Kearney

Attachment

Copy: NRC Region I
Mr. P. W. Finney, NRC Sr. Resident Inspector
Mr. R. R. Janati, DEP/BRP
Mr. B. K. Vaidya, NRC Project Manager

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES:10/31/2013

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA/Privacy Section (T-5 F53), U. S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resources@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Susquehanna Steam Electric Station Unit 2	05000388	1 OF 4

4. TITLE

Unit 2 Scram due to Main Turbine Trip during ICS Surveillance Testing

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
08	19	2011	2011	- 003 -	00	10	18	2011		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

100%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below

12. LICENSEE CONTACT FOR THIS LER

Facility Name	Telephone Number (Include Area Code)
Brenda W. O'Rourke, Senior Engineer - Nuclear Regulatory Affairs	(570) 542-1791

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On August 19, 2011, at 10:46 hours, Susquehanna Steam Electric Station (SSES) Unit 2 automatically scrammed from 100 percent power due to a main turbine trip. The main turbine trip occurred during the performance of the quarterly functional surveillance test of the reactor water high level trip channels for feedwater / main turbine. The surveillance test was being performed for the first time since the 2011 upgrade of the Unit 2 feedwater level control system with a digital Integrated Control System (ICS). As part of the test, operations personnel transferred the reactor water level input signal from average level to narrow range 'B' biased as required by the procedure. The main turbine and feedwater trip system design uses three narrow range reactor water level channels in a two-out-of-three trip logic. When the first narrow range reactor water level channel ('2A') was tested, an unexpected automatic main turbine trip occurred. ENS notification (47172) was made to the NRC in accordance with 10 CFR 50.72(b)(2)(iv) for an event or condition that resulted in the actuation of the RPS when the reactor was critical, and 10 CFR 50.72(b)(3)(iv)(A) due to a valid actuation of the RPS. This Licensee Event Report is being submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A). This event had no impact to the health and safety of the public.

The direct cause was an incorrectly terminated internal jumper. The wiring anomaly in the ICS Level 8 turbine trip logic circuitry resulted in one of the Level 8 trip logic contacts being jumpered out of the channel trip circuitry, causing a Unit 2 main Turbine Trip from the initiation of one single channel instead of the designed two-out-of-three channel logic.

The root causes for this event are 1) Conflicting and unclear procedure requirements, and less than adequate (LTA) reinforcement of management expectations for work package content resulted in a key visual check of internal jumpers being omitted from the scheme check work package during its preparation. Therefore, testing failed to check and discover the miswired jumper, 2) LTA procedure adherence during development of engineering change functional testing resulted in insufficient testing of the ICS Level 8 main turbine trip logic, and 3) The work order review process weaknesses related to procedure content, procedure adherence, reinforcement of expectations, and definition of work order scope resulted in the review of the ICS Level 8 scheme check work package not identifying the missing key internal jumpers. This resulted in a missed opportunity to identify the incorrectly terminated conductor.

Corrective actions include 1) Revise the control scheme testing procedure to clearly identify the specific responsibilities of the preparer, technical reviewer and the implementer of scheme checks and to align scheme check work order content to meet requirements of SSES maintenance work practices, 2) Require the use of risk managed defenses for functional test procedure development and field installation activities for risk significant modifications, 3) To improve the use of and compliance with procedures on a sustainable basis, and reinforce through observation, the use of the SSES Station Fundamentals Tool Kit that the 'Procedures' core fundamental and supporting behaviors shall be maintained, and 4) Conduct reinforcement sessions regarding management's expectation for scheme check work order preparation, technical review and implementation support.

LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Susquehanna Steam Electric Station Unit 2	05000388	2011	--003--	00	2 OF 4

NARRATIVE

CONDITION PRIOR TO THE EVENT

Unit 2 - Mode 1, 100 percent Rated Thermal Power

EVENT DESCRIPTION

On August 19, 2011, at 10:46 hours, Susquehanna Steam Electric Station (SSES) Unit 2 automatically scrammed from 100 percent power due to a main turbine trip. The main turbine trip occurred during the performance of the quarterly functional surveillance test of the reactor water high level trip channels for feedwater / main turbine.

The surveillance test was being performed for the first time since the 2011 upgrade of the Unit 2 feedwater level control system with a digital Integrated Control System (ICS). As part of the test, operations personnel transferred the reactor water level input signal from average level to narrow range 'B' biased as required by the procedure. The main turbine and feedwater trip system design uses three narrow range reactor water level channels in a two-out-of-three trip logic. When the first narrow range reactor water level channel ('2A') was tested, an unexpected automatic main turbine trip occurred. An investigation revealed an internal jumper was incorrectly terminated. The wiring anomaly in the ICS Level 8 turbine trip logic circuitry resulted in one of the Level 8 trip logic contacts being jumpered out of the channel trip circuitry, causing a Unit 2 main Turbine Trip from the initiation of one single channel instead of the designed two-out-of-three channel logic.

Actual reactor vessel water level was within the normal band when the main turbine tripped. The main turbine trip resulted in a reactor scram and the reactor recirculation pump trips as designed. All control rods fully inserted. Reactor water level lowered to +2 inches causing Level 3 (+13 inches) isolations.

Reactor water level was restored to normal operating band using the feedwater system. Level setpoint setdown to +18 inches occurred as designed. Due to loss of forced core recirculation flow and potential for reactor thermal stratification, control rod drive system flow was reduced and reactor water level was raised to provide natural circulation flow. The reactor recirculation pumps were subsequently restarted to re-establish forced core circulation. The maximum differential temperature observed between the bottom head region and bulk coolant temperature was 92 degrees Fahrenheit, which was within the 145 degree Fahrenheit pump start limit.

Six main steam relief valves (SRVs) opened for a short duration as expected due to the turbine trip transient. The main steam isolation valves (MSIV's) remained open during the transient. Reactor pressure was controlled via turbine bypass valve operation. A management decision to not initiate a forced cooldown was made, and reactor pressure slowly lowered due to insufficient core decay heat to maintain normal operating pressure. The gradual cooldown did not challenge the 100 degree Fahrenheit cooldown limit. No Emergency Core Cooling Systems (ECCS) or Reactor Core Isolation Cooling (RCIC) system initiations occurred or were required.

ENS notification (47172) was made to the NRC in accordance with 10 CFR 50.72(b)(2)(iv) for an event or condition that resulted in the actuation of the RPS when the reactor was critical, and 10 CFR 50.72(b)(3)(iv)(A) due to a valid actuation of the RPS. As such, this Licensee Event Report is being submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A) for an event that resulted in the automatic actuation of the RPS.

CAUSE OF THE EVENT

Direct Cause:

- The incorrect termination of a single internal jumper in the ICS Level 8 trip circuit was the direct cause of the August 19, 2011, Unit 2 scram event.

The internal jumper was installed in March 2009 during field wiring of the ICS panels. The design documentation, installation work package, and verification sign-off indicate that the conductor was properly terminated at the appropriate connection point in the ICS panel. A photograph of the panel made in June of 2010 for other reasons shows the jumper incorrectly terminated.

Between March 2009 and June 2010, the ICS cabinet was the location of other work activities though none should have changed the termination of the field jumper and there was no clear evidence suggesting that the termination was changed in this time period.

The root cause team was not able to reliably identify when, by what work group, or by what work mechanism the incorrect termination was made. Without knowing the origin of the incorrect termination, this occurrence cannot be analyzed to definitively identify the fundamental reasons it may have occurred. Hence, this direct cause cannot be taken as a root cause of this event. In addition, reliable "prevent recurrence" actions cannot be prescribed.

Three Root Causes were identified:

- Conflicting and unclear procedure requirements and less than adequate reinforcement of management expectations for work package content resulted in a key visual check of internal jumpers being omitted from the scheme check work package during its preparation, and therefore testing failed to check and discover the miswired jumper.

- Less than adequate procedure adherence during development of engineering change functional testing resulted in insufficient testing of the ICS Level 8 main turbine trip logic.

- The PCWO (plant control work order) review process weaknesses related to procedure content, procedure adherence, reinforcement of expectations, and definition of PCWO work scope resulted in the review of the ICS Level 8 scheme check work package not identifying the missing key internal jumpers. This resulted in a missed opportunity to identify the incorrectly terminated conductor.

ANALYSIS / SAFETY SIGNIFICANCE

Actual Consequences

The Unit 2 main turbine tripped when a single channel high reactor water level signal was inserted during a quarterly functional surveillance test of the reactor water high level trip channels for feedwater / main turbine. The main turbine trip resulted in a reactor scram. All control rods fully inserted. The reactor feed pump turbines remained in service, as expected, for a single channel high water level signal. Actual reactor vessel water level was within the normal band when the main turbine tripped. The reactor recirculation pumps tripped as designed. Reactor water level lowered to +2 inches causing Level 3 (+13 inches) isolations. The operating '2A' reactor water cleanup (RWCU) pump tripped unexpectedly. Although the RWCU system did not isolate, the pump trip resulted in a loss of RWCU system flow and loss of continuous reactor water conductivity monitoring.

Reactor water level was restored to the normal operating band using the feedwater system. Six main steam relief valves opened for a short duration as expected due to the turbine trip transient. Subsequently, reactor pressure was controlled via turbine bypass valve operation. All safety systems operated as expected. No ECCS or RCIC initiations occurred or were required. There were no diesel generator starts. The reactor recirculation pumps were subsequently restarted to re-establish forced core circulation. Unit 1 was unaffected and continued power operation. This event is bounded by transients analyzed in Chapter 15 of the SSES Final Safety Analysis Report (FSAR). FSAR Section 15.2.3 specifically analyzed a turbine trip with the steam bypass system operable as a non-limiting event.

Based upon the above discussion, the actual consequences of this event were minimal. There were no adverse radiological safety or industrial safety consequences and no impact to the health and safety of the public.

Potential Consequences

The PRA model was configured to reflect a Susquehanna Unit 2 non-isolation initiating event (no MSIV closure). These non-isolation events occur from loss of feedwater or main turbine trip. Failure of the 'D' ESW pump was included in the risk assessment calculation since the pump was out of service.

The PRA risk model was quantified and applied over a reactor year to yield the risk probability. The resulting calculated risk of the initiating event is less than 1E-06 for core damage probability (CDP) and 1E-07 for large early release probability (LERP). This calculation is bounding and represents a very small change in risk as a result of the initiating event.

CORRECTIVE ACTIONS

Key Planned Corrective Actions

- Revise the Control Scheme Testing procedure to clearly identify the specific responsibilities of the preparer, technical reviewer and implementer of scheme checks and to align scheme check work order content to meet requirements of SSES Maintenance Work practices.
- Revise the procedure for Control Scheme Testing to define the scope of considerations to be included in technical reviews of scheme check work orders and require the use of highlighted drawings that define the work order scope.
- Work group supervision shall conduct reinforcement sessions of management expectations for scheme check work order preparation, technical review and implementation support.
- Require the use of Risk Managed Defenses for functional test procedure development and field installation activities for risk significant modifications.
- To improve the use of and compliance with procedures on a sustainable basis, and reinforce through observation, the use of the SSES Station Fundamentals Tool Kit that the 'Procedures' core fundamental and supporting behaviors shall be maintained.